Space Weather Technical Forecast

Issued on Wednesday, 08 December 2021 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Storms on Days 2 and 3 (09 and 10 Dec).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours, with just one B-class flare at 07/1905 UTC. There was one sunspot on the visible disc, which was classified as Axx/Alpha, but this region has faded to plage during the past 12 hours. No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR at L1, has been slightly elevated, but generally declined from around 500 km/s to around 420 km/s. Density was average (5-10 ppcc) throughout. The IMF, Bt, was weak at 5 nT or below, and the north-south component (Bz) varied between +4/-3 nT. The phi angle was predominately positive (away from the Sun). The resultant geomagnetic activity was Quiet (Kp 0-2). These parameters suggest a waning connection to a high speed stream from CH27/28 (no longer visible on the disc).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at Background levels. The high energy electron flux (greater than 2 MeV) was at Background to Moderate levels, with a diurnal peak of 950 pfu at 07/1435 UTC. The associated 24-hour integrated fluence has been and has remained below the Active threshold (1e8 integrated pfu), with 3.54e7 integrated pfu observed at 08/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to stay predominantly Very Low during the forecast period.

Solar Wind / Geomagnetic Activity: There are two potentially Earth-directed CMEs in the forecast. The first CME is expected to arrive on Day 2 (9th) at 1800UTC +/-9 hours, but confidence is low. The second CME will likely arrive at Earth as a weak feature on Day 3 (10th) around 0900 UTC +/-12hrs.
The current slightly elevated wind speeds from CH27/28 are expected to ease to background levels during day 1 (8th). Further fast wind enhancements are possible during Day 2 (9th) from CH29 and days 3/4 (10th/11th) due to CH30.
Quiet Geomagnetic activity is expected to become Quiet to Unsettled from day 2 (9th), with a chance of isolated Active intervals. There is a 20% Chance of G1/Minor Storms on days 2 and 3 (9th and 10th) should the CMEs arrive, perhaps coinciding with the fast winds from CH29 and CH30.

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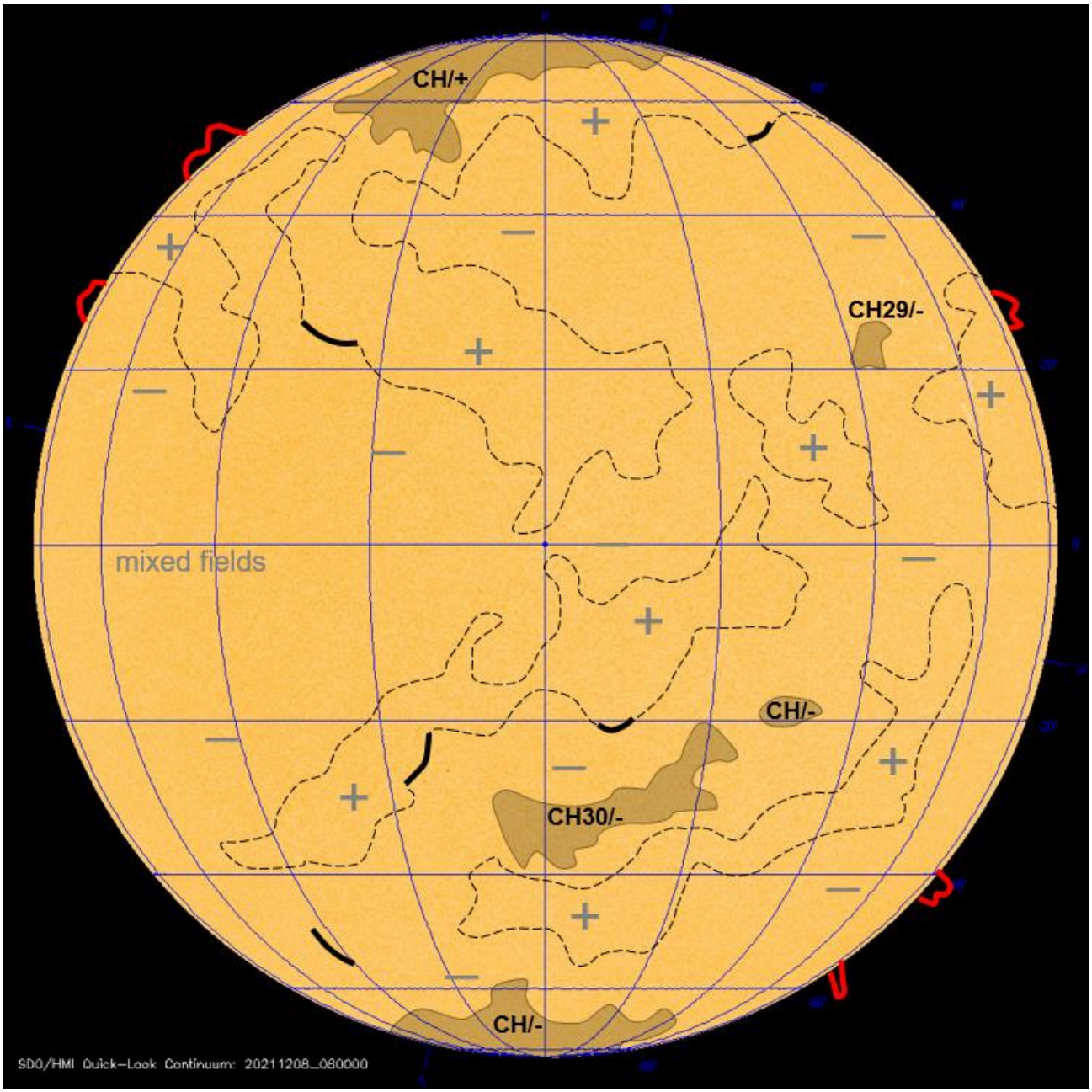
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels.
The high energy electron flux (greater than 2 MeV) is likely to peak at Moderate, perhaps High levels. The associated 24-hour integrated fluence is expected to persist below the Active threshold, possibly on a slight rising trend, with a Slight Chance of rising above Active. Confidence is low beyond the immediate term owing to the number of (potential) transients in the forecast.

Figure 1. Solar Analysis Valid 08/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are now two potentially Earth-directed CMEs in the forecast, with an earlier CME now considered to have missed Earth.
The first CME is a faint emission from a filament eruption on 05 December, and is expected to arrive on Day 2 (09 Dec) at 1800 UTC +/-9 hours, but confidence is low due to limited imagery for analysis.
The second CME which left the Sun as a filament lift-off late on 05 December will likely arrive at Earth as a weak feature on Day 3 (10 Dec) around 0900 UTC +/-12hrs.
The current slightly elevated wind speeds from CH27/28 are expected to ease to background levels today (8th). Further fast wind enhancements are possible during Day 2 from CH29, however this feature appears to be closing up and is small and likely very weak, and on the 10th and 11th due to CH11. However, no significant enhancement has been observed at STEREO-A at the time of writing, which is currently ~2.8 days ahead of Earth, but slightly further north with respect to CH30.
Predominantly Quiet geomagnetic activity is expected to become Quiet to Unsettled on day 2 (9th), with a chance of isolated Active intervals through the remainder of the forecast period. Overall, there is a slight chance (20%) of G1/Minor Storms on Days 2 and 3 (9th and 10th) should the CMEs arrive, perhaps coinciding with the arrival of the fast winds of CH29 and CH30.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
05/2337	Partial	Filament eruption	South centre disc	325 km/s	09/1800 UTC	Limited shock expected
06/1613	Partial	Filament eruption	SE quadrant	310 km/s	10/0900 UTC	Limited shock expected

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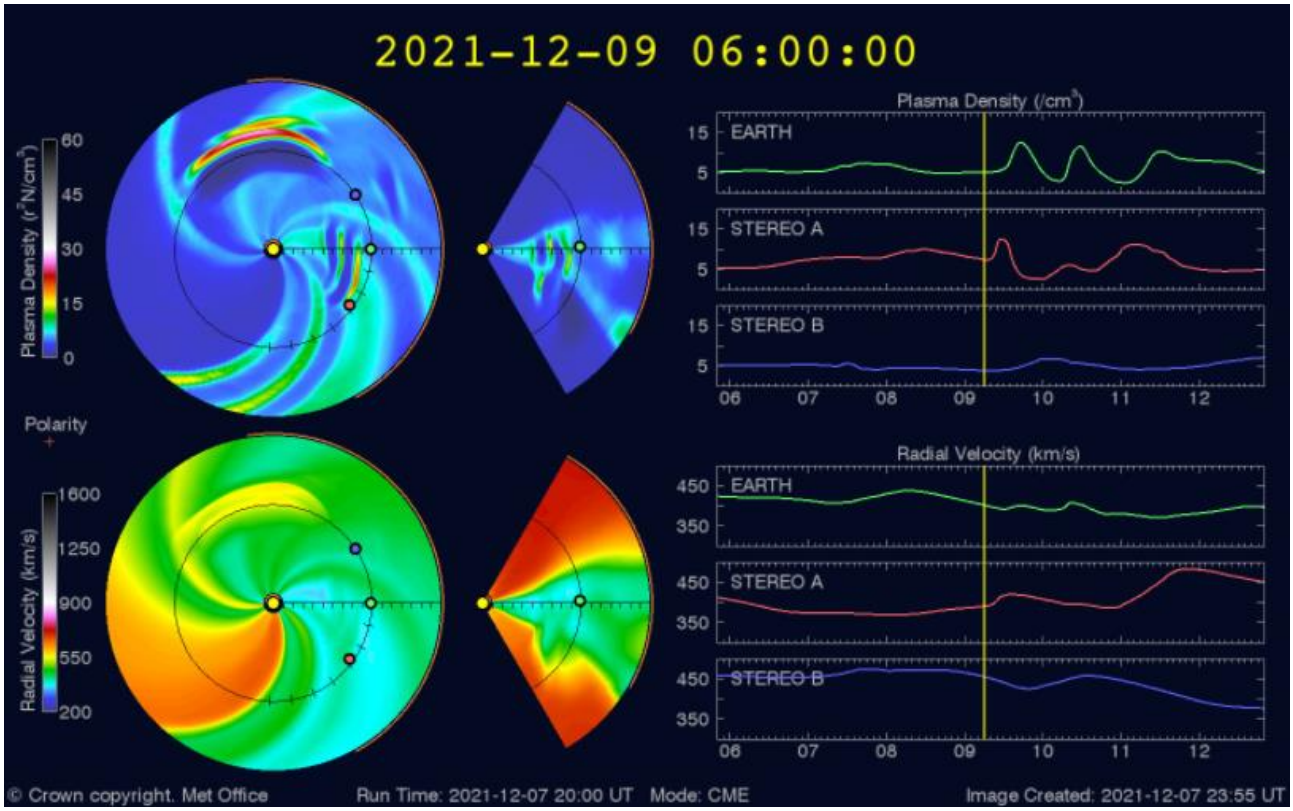
Figure 2: Enlil showing two potential CME arrivals on 9th and 10th December.



Radio Blackouts - X-Ray Flares:

Solar Activity has been Very Low in the past 24 hours. There was one small and simple sunspot region (2904), but this has recently faded to plage. There is a slightly brighter region showing on STEREO-A EUVI imagery which may be a new region to rotate onto the disc on Day 3 (10 Dec) but confidence is low. Therefore, solar activity is expected to remain predominantly Very Low through the forecast period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 has reached the top end of Moderate levels during the last 24 hours, and is forecast to persist near this level, with a chance of seeing peak values reach High levels. There is the potential for a dropout in values from any geomagnetic activity due to CME and/or CH29 and CH30 high speed stream arrivals on Days 2 and 3 (9th and 10th). This may be followed by an increase in values on Day 4 (11th), but this is low confidence.
The associated fluence may rise slightly on Day 1 (8th), but is likely to stay below Active with only a slight chance of rising above. Thereafter fluence may well drop in the wake of CME or HSS arrival, before a possible recovery on Day 4. REFM is currently suggesting a rise close to Active levels on Day 1, but this is considered to be too high with a continuation of fluence below the Active threshold most likely.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	20	20	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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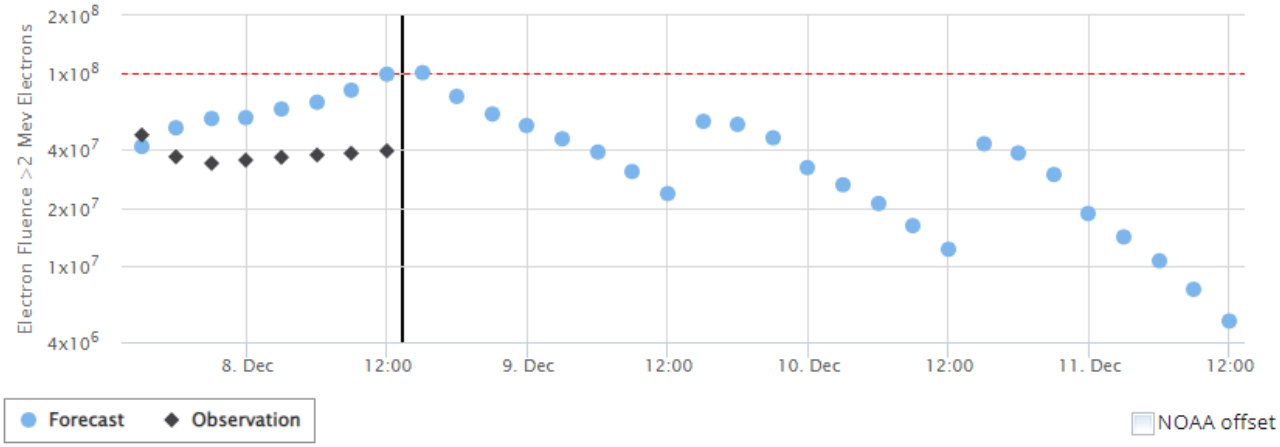
Figure 3: REFM model showing a rise, which is considered to be unlikely.



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